[DOCUMENT] CLAIMS

[Claim 1]

An optical encoder comprising:

a light source;

a first grating, which is composed of an amplitude grating having a first grating period, for spatial amplitude modulation of light from the light source;

a second grating, which is composed of a phase grating having a second grating period, for spatial phase modulation of light from the first grating;

a third grating, which is composed of an amplitude grating having a third grating period, for spatial amplitude modulation of light from the second grating; and

a light receiving element for receiving light of the third grating,

wherein the encoder detects a relative displacement between the respective gratings.

[Claim 2]

The optical encoder according to Claim 1, wherein the second grating is composed of a transparent phase grating having an indented shape with a duty ratio of substantially 50%, in which optical path difference between the ridge and the valley thereof is substantially equal to $\lambda/2$ where λ is wavelength of light.

[Claim 3]

The optical encoder according to Claim 1, wherein the second grating is composed of a transparent phase grating having an indented shape with a duty ratio of substantially 50%, in which optical path difference between the ridge and the valley thereof is substantially equal to $\lambda/4$ where λ is

wavelength of light.

[Claim 4]

The optical encoder according to Claim 1, wherein the second grating is composed of a reflective phase grating, and the first and third gratings are arranged on the same side with respect to the second grating.

[Claim 5]

The optical encoder according to Claim 4, wherein the second grating has an indented shape with a duty ratio of substantially 50%, in which optical path difference between the ridge and the valley thereof is substantially equal to $\lambda/4$, where λ is wavelength of light.

[Claim 6]

The optical encoder according to Claim 4, wherein the second grating has an indented shape with a duty ratio of substantially 50%, in which optical path difference between the ridge and the valley thereof is substantially equal to $\lambda/8$ where λ is wavelength of light.

[Claim 7]

The optical encoder according to Claim 1, wherein the first, the second and the third gratings have the same period P, and

both a first distance between the first and the second gratings and a second distance between the second and the third gratings are designed substantially to odd integral multiple of $P^2/(4\lambda)$ where λ is wavelength of light.

[Claim 8]

The optical encoder according to Claim 1, wherein the second grating has a period P, and the first and the third gratings have the same period 2P, and

both a first distance between the first and the second gratings and a second distance between the second and the third gratings are designed to substantially odd integral multiple of $P^2/(4\lambda)$ where λ is wavelength of light.

[Claim 9]

The optical encoder according to Claim 1, wherein the second grating is composed of a phase grating in which optical path difference varies sinusoidally.

[Claim 10]

The optical encoder according to Claim 1, wherein a first distance between the first and the second gratings is different from a second distance between the second and the third gratings, and

the ratio of the first distance to the second distance is substantially equal to the ratio of a period of the first grating to a period of the third grating.

[Claim 11]

The optical encoder according to Claim 1, wherein the first, the second and the third gratings have scales of rotary type.

[Claim 12]

The optical encoder according to Claim 1, wherein the first grating has spatial distribution of transmittance varying sinusoidally.

[Claim 13]

The optical encoder according to Claim 1, wherein a plurality of light receiving elements are arranged discretely with the third grating period, and the third grating and the light receiving elements are integrated with each other.